Environmental Effects of Dust Suppressant Chemicals on Roadside Plant and Animal Communities in National Wildlife Refuges

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Dust from unpaved roads creates human health concerns in the form of inhalable particulate matter, road hazards due to reduced visibility, and compromised road surface durability through the loss of fine particles. Over 400 products in six major categories are commercially available for use as dust suppressants; however, many of these products are poorly characterized and lack reliable toxicity and environmental fate data. Because these products may be applied to roadways in sensitive habitats and enter roadside ecosystems, we completed an initial toxicity assessment of eight commercial dust suppressants representing four suppressant categories (organic petroleum, organic non-petroleum, synthetic polymer emulsion, and electrochemical). Each product was tested in its original form, as well as an aged form exposed to 200-700 nm ultraviolet (UV) radiation for 48 hours prior to testing. Our objectives were to 1) determine the toxicity of dust suppressant products in water to a representative vertebrate (rainbow trout-*Oncorhynchus mykiss*) and 2) compare sensitivity of test organisms to aged and unaged products. In general, synthetic polymers were the product class exhibiting the lowest toxicity to rainbow trout, with 96-h LC50s greater than 1,000 mg/L. The two most toxic products—one enzyme-based (electrochemical class) and one modified from soybean oil (organic non-petroleum class)—were approximately two orders of magnitude more toxic (96-h LC50s 10-25 mg/L), a result not anticipated from Material Safety Data Sheet (MSDS) or other product information. Results from UV-aged exposures were generally consistent with those from unaged dust suppressants, with the exception of one organic petroleum product. In this case, UV aging enhanced toxicity to rainbow trout nearly four-fold. These results underscore the need for more extensive ecotoxicological testing of dust suppressants, as well as the necessity of considering potential toxicity resulting from product degradation.

Whereas previous studies evaluated the toxicity of unaged and aged parent products in water (simulating the entry of products into aquatic habitats through overspray during initial application), tests currently underway will determine the toxicity to rainbow trout of dust suppressant products aged on soil substrates and then physically weathered (as would be the case as a treated road bed degrades over time, allowing soil particles and associated weathered product to wash into roadside habitats). Products will be applied to a homogenized soil mixture at the manufacturer's recommended rate and at two times the recommended rate in a manner simulating recommended road bed preparation. Fish will be exposed to an elutriate prepared from the cured soil treatments.

At the completion of these studies, 3-4 of the least toxic products will be evaluated for potential use on wildlife refuge lands. These tests will use a wider range of aquatic and terrestrial species, potentially including such organisms as duckweed, crayfish, midge, amphipods, earthworms and ryegrass, and are expected to continue through April 2010.

Potential study sites are being considered for field tests tentatively scheduled to begin Fall 2009. Site selection criteria include 1) sufficient road lengths to allow replicated applications of three different products, 2) no history of dust suppressant treatment, 3) light to moderate traffic, 4) a relatively uniform vegetation community, and 5) location within convenient travel distance. Pre- and post-treatment assessments of roadside community composition will be conducted, in addition to collection of treated road materials and adjacent soils. Collected materials will be used for soil characterizations and in laboratory toxicity tests to confirm the results of 2009 substrate tests. In-situ tests of potential toxicity will also be conducted following field applications, using caged aquatic and terrestrial organisms and seedling transplants. The field studies will be conducted through 2012.

Summary Project Timeline

Spring-Summer 2009	Rangefinder and definitive laboratory toxicity tests with rainbow trout and aged and unaged products
Summer-Fall 2009	Laboratory tests with rainbow trout and weathered products on soil substrates
Fall 2009	Preliminary site selection for field trials begins
Fall 2009-Spring 2010	Toxicity testing with expanded suite of species
Spring 2010-2012	Field tests with pre- and post-application assessment